

Review of the species of *Pelodiaetodes* Moore (Coleoptera: Carabidae: Bembidiini: Anillina) of New Zealand

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Abstract

Four new species of the formerly monotypic genus *Pelodiaetodes* are described from New Zealand. Three of them: *P. constricticollis*, sp. n., *P. moorei*, sp. n., and *P. aldermensis*, sp. n., occurring on the North Island, are morphologically similar to the type species, *P. prominens* Moore. The fourth species, *P. nunni*, sp. n., occurring on the South Island, is morphologically distinct from the nominotypical species group. A new subgenus, *Monosetodes*, subgen.n., is proposed to accommodate *P. nunni* within *Pelodiaetodes*. Redescriptions of the genus and the type species are given based on new morphological data, and a taxonomic key as well as a distribution map for all known species are provided. Some biogeographical aspects of the evolutionary history of *Pelodiaetodes* and its morphological relatives from Madagascar, Australia and New Zealand are discussed.

Key words: Adephaga, *Pelodiaetodes*, Carabidae, Coleoptera, new species, new subgenus, New Zealand, southern Gondwana pattern

Introduction

The genus *Pelodiaetodes* was erected by B.P. Moore (1980) for peculiar anilline carabid specimens, collected in the northern part of the North Island of New Zealand. These specimens demonstrated the distinct elytral longitudinal groove, while possessing a complete number of setae in the elytral series of umbilicate marginal pores. The only known New Zealand anillines with grooved elytra at that time were representatives of the genus *Pelodiaetus* Jeannel. Externally, members of both genera are similar and this similarity was reflected in the name of the new genus *Pelodiaetodes* (from *Pelodiaetus* and the Greek “*eîdos*”, meaning “resembling *Pelodiaetus*”). Moore (1980) proposed the following list of diagnostic characteristics to distinguish representatives of *Pelodiaetodes*: complete (*Pelodiaetodes*) or incomplete (*Pelodiaetus*) elytral umbilical series of pores, slightly (*Pelodiaetodes*) or strongly (*Pelodiaetus*) inflated penultimate maxillary palpomere, and the presence (*Pelodiaetodes*) or absence (*Pelodiaetus*) of an auxiliary tubercle anterior to the posterior angles of the pronotum. Until now, the genus *Pelodiaetodes* included only one species: *P. prominens* Moore.

Presence of longitudinal grooves on the elytra is not a common character within representatives of the Anillina. Thus far, only six genera with grooved elytra have been described among the more than 80 genera of anillines known to date (Lorenz 2005; Giachino 2005, 2008; Giachino & Vailati 2011; Sokolov 2013). In addition to New Zealand’s *Pelodiaetus* and *Pelodiaetodes*, one genus, *Illaphanus* Macleay, is from the Australian continent (Jeannel 1937, 1963; Giachino 2005), and three genera, *Malagasytyphlus* Giachino, *Malagasydipnus* Giachino, and *Bulirshia* Giachino, are confined to Madagascar (Giachino 2008). Their listed ranges correspond to the territories of the ancient East Gondwanan continent (Seton *et al.* 2012; Gibbons *et al.* 2013), suggesting the Gondwanan origin of this group of anillines if monophyly of the group is supported.

I had the opportunity to investigate the material of Anillina from the New Zealand Arthropod Collection and the private collection of J.T. Nunn, who used numerous collecting methods including a soil-washing technique, which greatly enriched the number of subterranean species available for study. After preliminary sorting of the material of the genus *Pelodiaetodes* it was discovered there were in fact five species, four of which were new to the scientific community. This increase in the number of species in the formerly monotypic genus made it necessary to

redefine *Pelodiaetodes*. Consequently, redescriptions of the genus and type species, and descriptions of the four newly discovered species are presented here.

Material and methods

This study is based on the examination of 104 specimens of *Pelodiaetodes* from the New Zealand Arthropod Collection (NZAC), Auckland, New Zealand, and from the personal collection of John T. Nunn (JTN), Dunedin, New Zealand. Verbatim label data are given for type specimens of all newly described taxa, with label breaks indicated by a slash (“/”).

Measurements. All specimens were measured electronically using a Leica M420 microscope equipped with a Syncroscopy AutoMontage Photomicroscopy system (SYNCROSCOPY, Synoptics Ltd.). Measurements for various body parts are encoded as follows: LH = length of head, measured along midline from anterior margin of labrum to the virtual line, connecting posterior supraorbital setae; WH = width of head, at level of anterior supraorbital setae; WPm = maximal width across pronotum; WPa = width across anterior angles of pronotum; WPp = width across posterior angles of pronotum; LP = length of pronotum from base to apex along midline; WE = width of elytra, at level of 4th umbilicate setae; LE = length of the elytra, from apex of scutellum to apex of left elytron; SBL = standartized body length, a sum of LH, LP and LE. SBL measurements are given in mm; others are presented as nine ratios: mean widths-WH/WPm and WPm/WE and body parts-WPa/WPp, WPm/WPp, WPm/LP, WE/SBL, WE/LE, LE/SBL, and LP/LE. All values are given as mean \pm standard deviation.

Illustrations. Digital photographs of the dorsal habitus of new species were taken with the AutoMontage system using a Leica M420 microscope. Line drawings of selected body parts were made using a camera lucida on an Olympus BX 50 microscope. Scanning electron micrographs were made with coating on an ESEM FEI Quanta 200.

Dissections. Method of dissections follows that of Sokolov (2013) and Sokolov *et al.* (2014).

Type material. I had no opportunity to investigate the type material of the New Zealand anillines with grooved elytra. The concept of *Pelodiaetodes* and *Pelodiaetus* used in this paper, is based on the material, identified by B. P. Moore during his work on the New Zealand fauna of Anillina, including several specimens of *Pelodiaetodes prominens* from the type locality.

Terms. Terms used in the paper follow Sokolov *et al.* (2004), Sokolov & Carlton (2008) and Sokolov (2013).

Species ranking. Species diagnoses are in accordance with the approach of Sokolov *et al.* (2004).

Descriptions. The scheme of descriptions follows that of Ball & Shpeley (2005, 2009).

Taxonomic treatment

Order Coleoptera Linnaeus, 1758

Family Carabidae Latreille, 1802

Subfamily Trechinae Bonelli, 1810

Tribe Bembidiini Stephens, 1827

Subtribe Anillina Jeannel 1937

Pelodiaetodes Moore 1980

Recognition. The members of this genus are distinguished from the other New Zealand representatives of Anillina by the following combination of characters: eyes absent; head with long fronto-lateral carinae; labium free, with distinct mental-submental suture; pronotum cordiform, with short subparallel basal constriction, with prominent anterior angles and distinct tubercle anterior to the posterior angles; each elytron with oblique longitudinal groove; last three pores of umbilicate series (7th, 8th and 9th) equidistant, but not aligned, virtually forming an obtuse isosceles triangle with 8th pore shifted towards disc. The cordiform pronotum with basal constriction, and grooved elytra distinguish the representatives of *Pelodiaetodes* from numerous New Zealand species of *Zeanillus* Jeannel and *Nesamblyops* Jeannel. Developed fronto-lateral carinae and grooved elytra separate *Pelodiaetodes* from the endogeal *Hygranalillus* Moore. A presence of the distinct tubercle anterior to the posterior angles of pronotum allows the separation of the species of *Pelodiaetodes* from the species of *Pelodiaetus*.

Description. *Size.* SBL range 1.38–1.72 mm.

Habitus. Body form weakly convex, subparallel (Fig. 5).

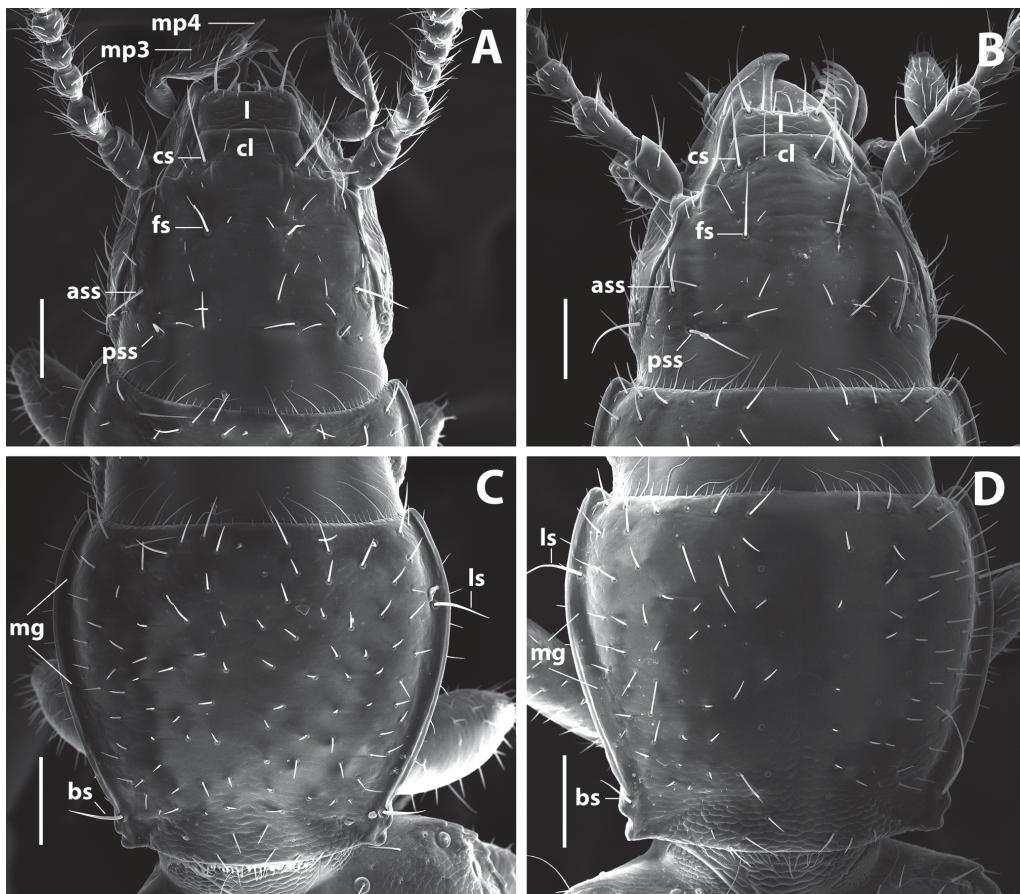


FIGURE 1. SEM illustrations of body parts of *Pelodiaetodes* species. Head, dorsal aspect: **A** *P. prominens*; **B** *P. nunni*. Pronotum, dorsal aspect: **C** *P. prominens*, **D** *P. nunni*. Legend: ass—anterior supraorbital seta; bs—basilateral pronotal seta; cl—clypeus; cs—clypeal seta; fs—frontal seta; l—labrum; ls—midlateral pronotal seta; mg—marginal pronotal gutter; mp3—maxillary palpomere3; mp4—maxillary palpomere 4; pss—posterior supraorbital seta. Scale bars = 0.1mm.

Color. Body brunneorufous or rufotestaceous, appendages testaceous.

Microsculpture. Dorsal microsculpture of polygonal sculpticells, on head, pronotum and elytra with isodiametric mesh pattern through over the dorsal surface. Development of microsculpture varies on different body parts. On head and disc of pronotum microlines less pronounced, fine, while on elytra microlines very distinct, forming well pronounced sculpticells with “scaly” mesh pattern.

Luster. Body surface shiny.

Macrosulpture. Body surface sparsely and finely punctate.

Vestiture. Body surface covered with sparse yellowish short setae. Vestiture of elytra short (less than one-third length of discal setae).

Fixed setae. Primary head setae include a pair of clypeal (cs), a pair of frontal (fs), a pair of anterior supraorbital (ass) and a pair of posterior supraorbital (pss) setae (Fig. 1A–B). Mentum with two pairs of long primary (paramedial and lateral) setae (Fig. 4C, pms, lms). Submentum with two pairs of long primary setae in two rows (lss, prss) and few additional shorter setulae (Fig. 4C). Maxilla with long stipetal and palpiferal setae (Fig. 4D). Pronotum with two long primary lateral setae (midlateral, ls, and basilateral, bs) on each side (Fig. 1C–D). Elytra either with 1 or 3 discal setae (Fig. 2C–D), with scutellar (ed2) and apical (ed8) setae. Last three (7th, 8th and 9th) pores (eo7, eo8 and eo9) of umbilicate series equidistant, but not aligned, with 8th pore shifted towards the disc and virtually forming an obtuse isosceles triangle. 7th pore aligned with 6th and 9th. Fifth visible sternite of male with two and of female with four setae along the posterior margin.

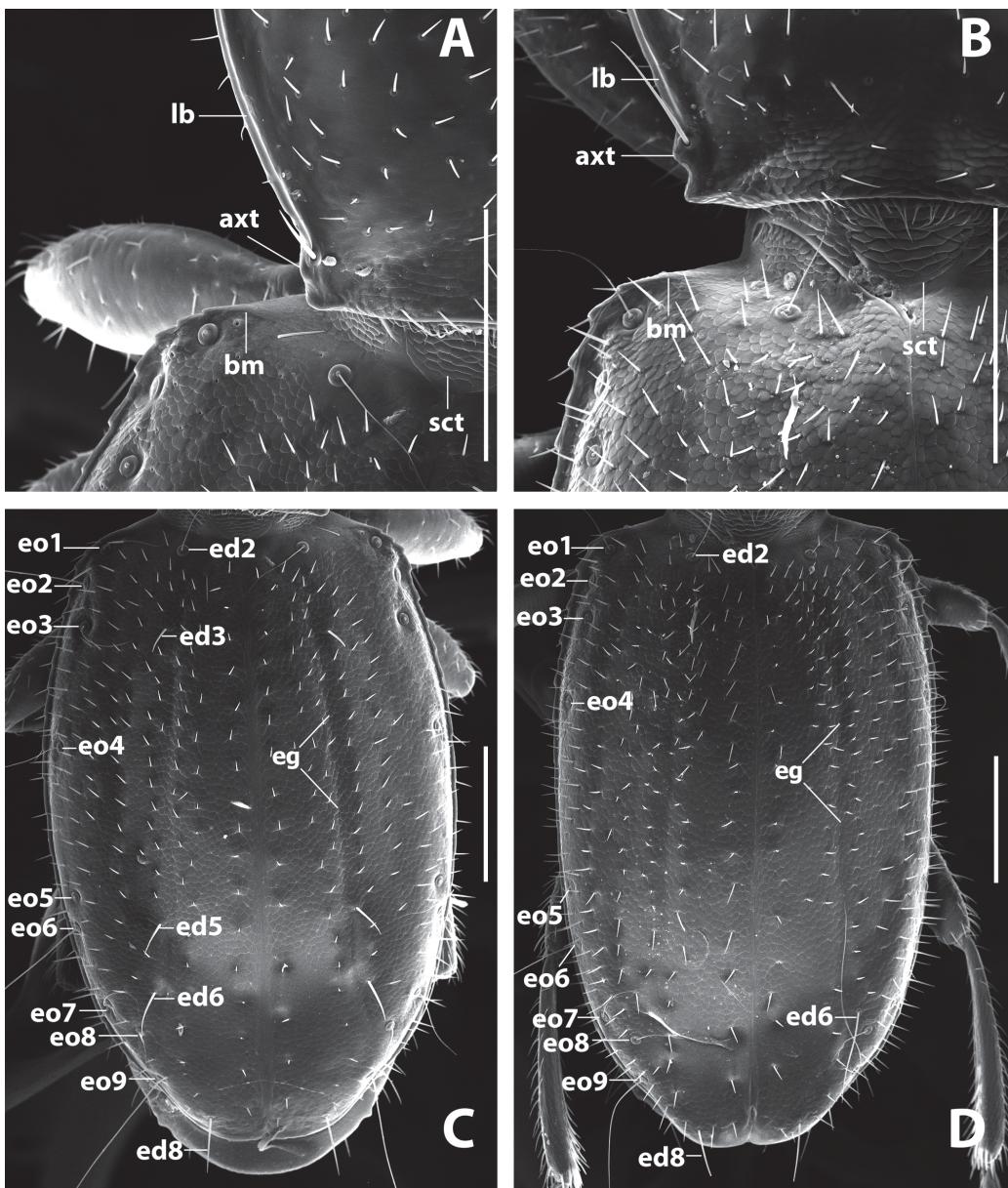


FIGURE 2. SEM illustrations of structural features of *Pelodiaetodes* species. Basal part of left elytron, dorsal aspect: **A** *P. prominens*; **B** *P. nunni*. Elytra, dorsal aspect: **C** *P. prominens*, **D** *P. nunni*. Legend: axt—auxillary tubercle; bm—basal margin; ed2—scutellar seta; ed3—ed6—discal elytral setae; ed8—apical elytral seta; eo1—9—setae 1—9 from the umbilicate series; eg—elytral groove; lb—lateral pronotal bead; sct—scutellum. Scale bars = 0.2mm.

Head (Fig. 1A–B). Anterior margin of clypeus (cl) straight. Frontal area flat without tubercle medially near frontoclypeal suture. Fronto-lateral carinae distinct and long.

Eyes. Eyes absent.

Antennae. Submoniliform, 11-segmented, extended to about posterior margin of pronotum. Antennomeres 1 and 2 elongate, of equal length and 1.4–1.5 times longer than antennomere 3, which is only slightly elongate and 1.2–1.3 times longer than antennomere 4. Antennomeres 4 to 10 globose, last antennomere conical and 1.6–1.8 times longer than penultimate antennomere.

Labrum (Fig. 1A–B). Labrum (l) transverse with almost straight, entire anterior margin and with six setae apically, increasing in size from the central pair outwards.

Mandibles (Fig. 4A–B). General plan of *Bembidion* type (Maddison 1993). Right mandible with distinct anterior (art) and posterior retinacular (prt), weakly developed terebral (tt), distinct premolar (pm) and molar (mt) teeth. Left mandible with distinct terebral (tt), premolar (pm) and molar (mt) teeth only.

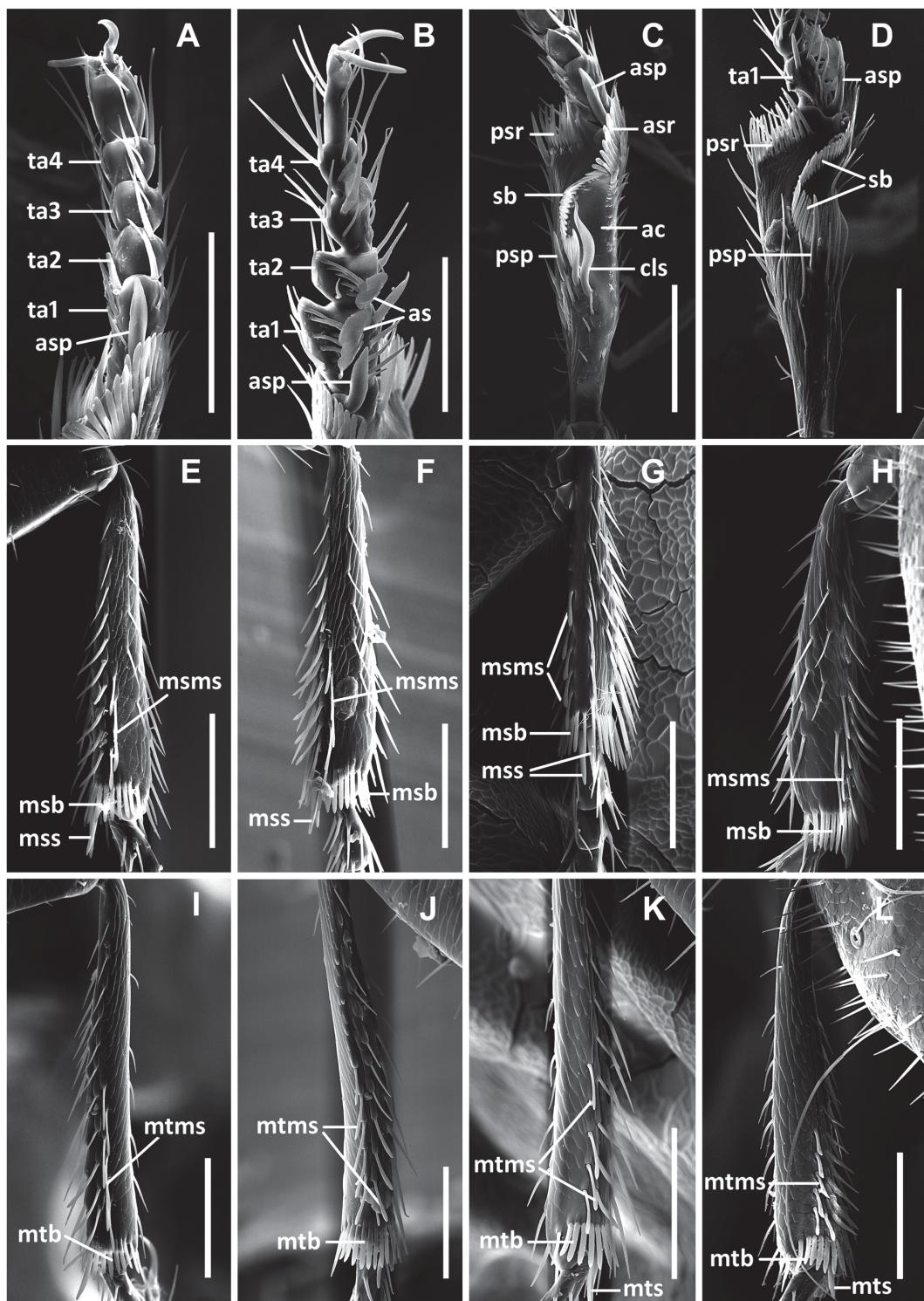


FIGURE 3. SEM illustrations of structural features of legs of *Pelodiaetodes* species, various aspects. **A–B** protarsus: **A** left protarsus of *P. nunni*, ventral aspect; **B** right protarsus of *P. aldermensis*, ventral aspect. **C–D** protibia: **C** left protibia of *P. nunni*, ventral aspect; **D** left protibia of *P. aldermensis*, medial aspect. **E–H** mesotibia: **E** right mesotibia of *P. prominens*, dorsal aspect; **F** right mesotibia of *P. aldermensis*, dorsal aspect; **G** right mesotibia of *P. moorei*, dorsal aspect; **H** left mesotibia of *P. nunni*, dorsal aspect. **I–L** metatibia: **I** right metatibia of *P. prominens*, dorsal aspect; **J** left metatibia of *P. aldermensis*, dorsal aspect; **K** left metatibia of *P. moorei*, dorsal aspect; **L** left metatibia of *P. nunni*, dorsal aspect. Legend: ac—antenna cleaner; as—adhesive seta; asp—anterior spur; asr—anterior setal row; cls—clip seta; msb—mesotibial brush; msms—mesotibial modified seta; mss—mesotibial spur; mtb—metatibial brush; mtms—metatibial modified seta; mts—metatibial spur; psp—posterior spur; psr—posterior setal row; sb—setal band; ta1–ta4—tarsomeres 1–4. Scale bars = 0.02mm.

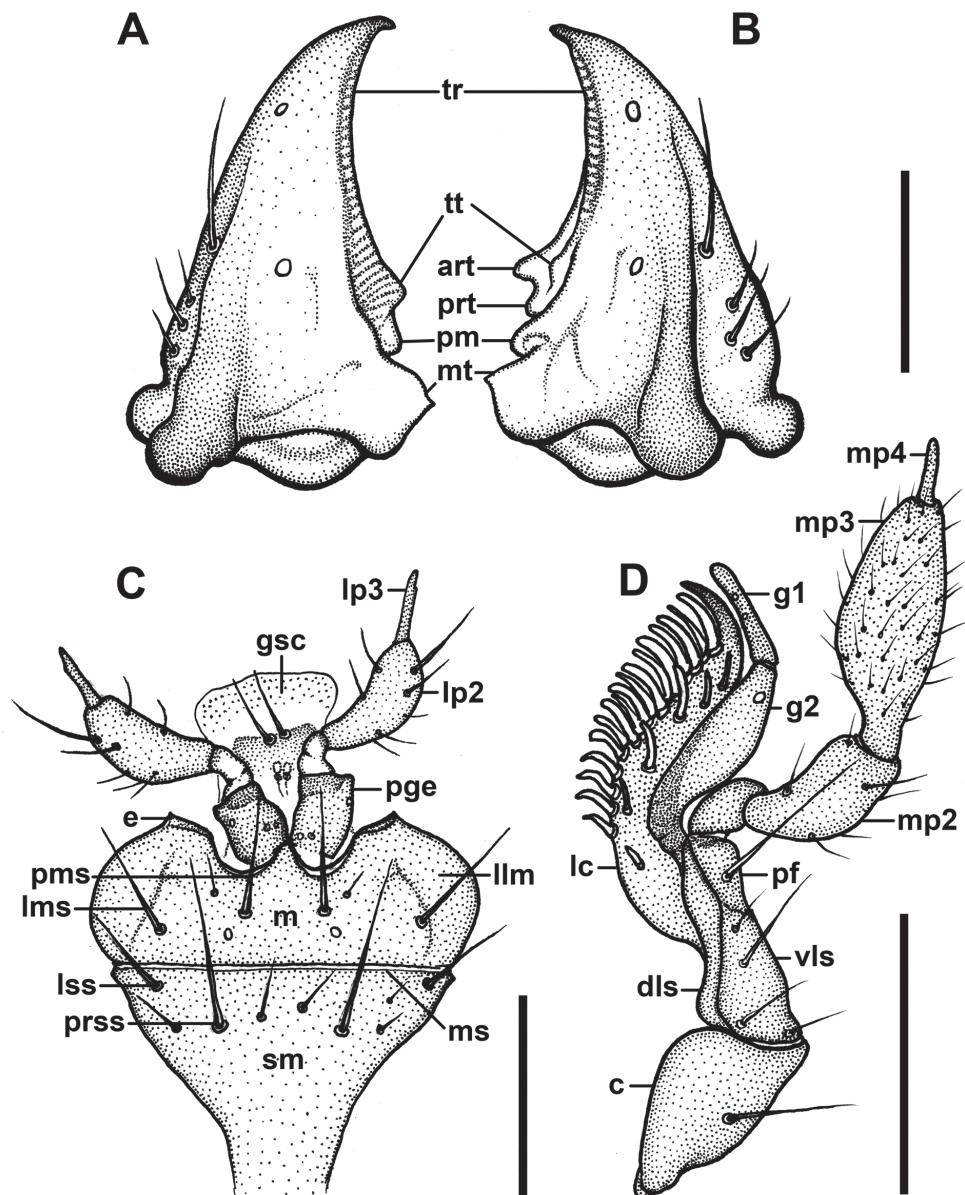


FIGURE 4. Line drawings of the mouthparts of *Pelodiaetodes prominens*. **A** left mandible, dorsal aspect; **B** right mandible, dorsal aspect; **C** labium, ventral aspect; **D** right maxilla, ventral aspect. Legend: art—anterior retinacular tooth; c—cardo; dls—dorsal lobe of stipes; e—epilobe of mentum; gsc—glossal sclerite; g1—galeomere 1; g2—galeomere 2; lc—lacinia; lms—lateral mental seta; lp2—labial palpomere 2; lp3—labial palpomere 3; lss—lateral submental seta; m—mentum; ms—mental-submental suture; mt—molar tooth; mp2—maxillary palpomere 2; mp3—maxillary palpomere 3; mp4—maxillary palpomere 4; pf—palpifer; pge—palpiger; pm—premolar tooth; pms—paramedial mental seta; prss—primary submental seta; prt—posterior retinacular tooth; sm—submentum; tr—terebrial ridge; tt—terebrial tooth; vls—ventral lobe of stipes. Scale bars = 0.1mm.

Maxillae (Fig. 4D). Maxillary palps similar to *Bembidion* (Maddison 1993) with basal trianguloid cardo, and stipes with dorsal and ventral lobes (dls, vls), dimerous galea (g1, g2), and standard lacinia (lc). Palpus with moderately long 4th palpomere (mp4), 0.25–0.30 length of palpomere 3 (mp3).

Labium (Fig. 4C). Labium with mental tooth; mentum (m) and submentum (sm) split, with mental-submental suture (ms) and with slightly enlarged lateral mental lobes (llm). Glossal sclerite (gsc) membranous apically, with two setae, paraglossae lacking.

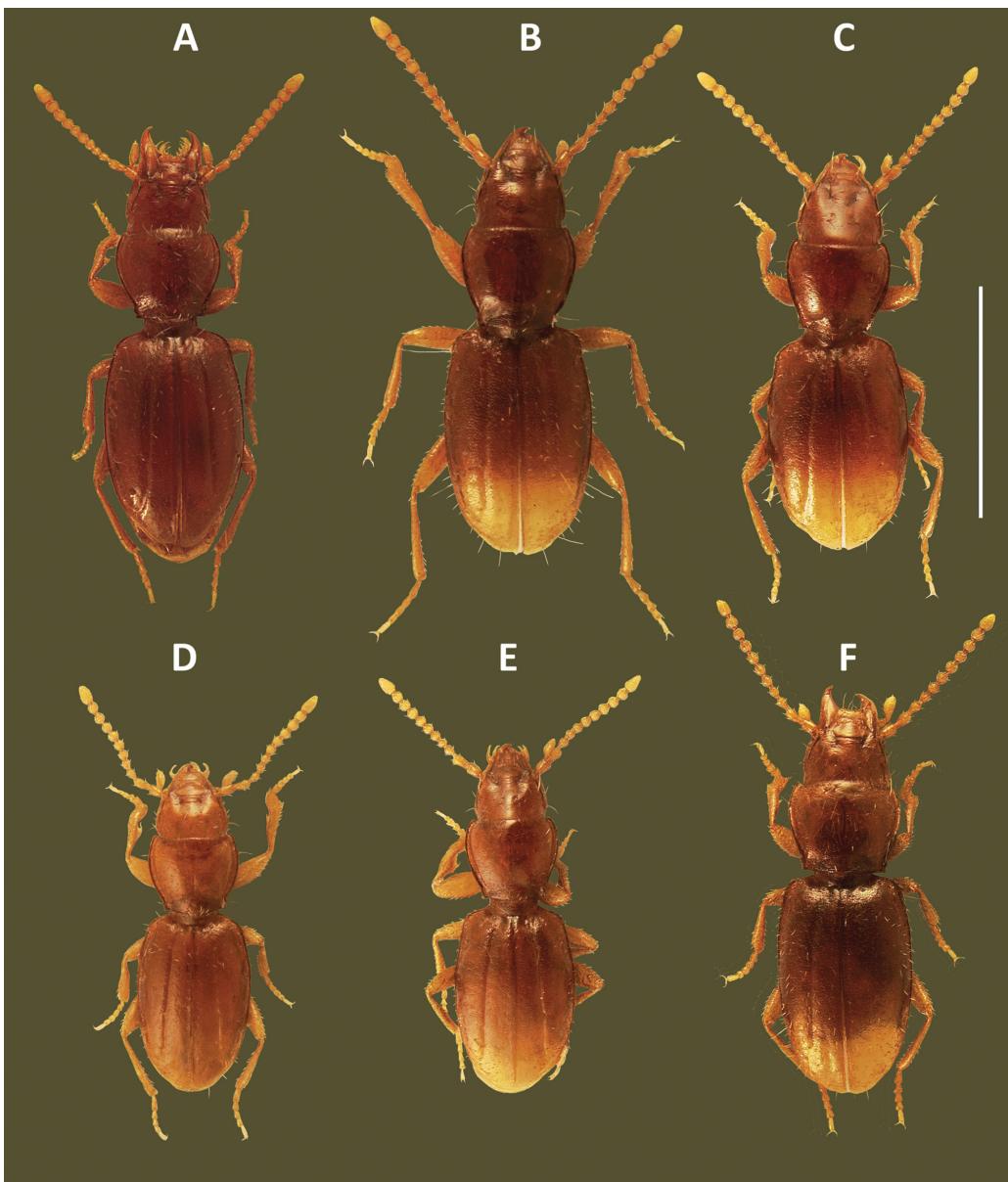


FIGURE 5. Digital images of habitus of *Pelodiaetodes* species, dorsal aspect. **A** *P. prominens* (NZ, Northland, Waipoua Forest); **B** *P. constricticollis* (NZ, Northland, Radar Bush), paratype; **C** *P. aldermensis* (NZ, Waikato, Aldermen Islands), paratype; **D** *P. moorei* (NZ, Northland, Poor Knight Islands), paratype; **E** *P. moorei* (NZ, Northland, Puketi Forest); **F** *P. nunni* (NZ, Otago, Oamaru), paratype. Scale bar = 1mm.

Prothorax (Fig. 1C–D, 6). Pronotum cordiform, moderately convex, slightly sinuate posteriorly, with wide marginal gutter (mg) and with short subparallel basal constriction. Posterior margin of pronotum almost straight, slightly oblique laterally. Anterior angles prominent, moderately protruding forward. Posterior angles denticulate, with 1 distinct tubercle (axt), bearing the basolateral seta, anterior to the angles (Fig. 2A–B). Widths across anterior margin much greater than between posterior angles (WPa/WPp varies from 1.15 to 1.24 among species).

Scutellum (Fig. 2A–B). Externally visible, triangular, with broadly rounded apex.

Elytra (Fig. 2C–D). Elytra relatively short (LE/SBL from 0.52 to 0.54 among species) without visible interneurs, but with oblique longitudinal groove (eg), stretching from the scutellar pore (ed2) downward to the 9th umbilical pore (eo9). Humeri rounded, to form oblique angle with longitudinal axis of body. Basal margination (bm) indistinct (Fig. 2A–B). Apical half of elytra with shallow subapical sinuation.

Hind wings. Absent.

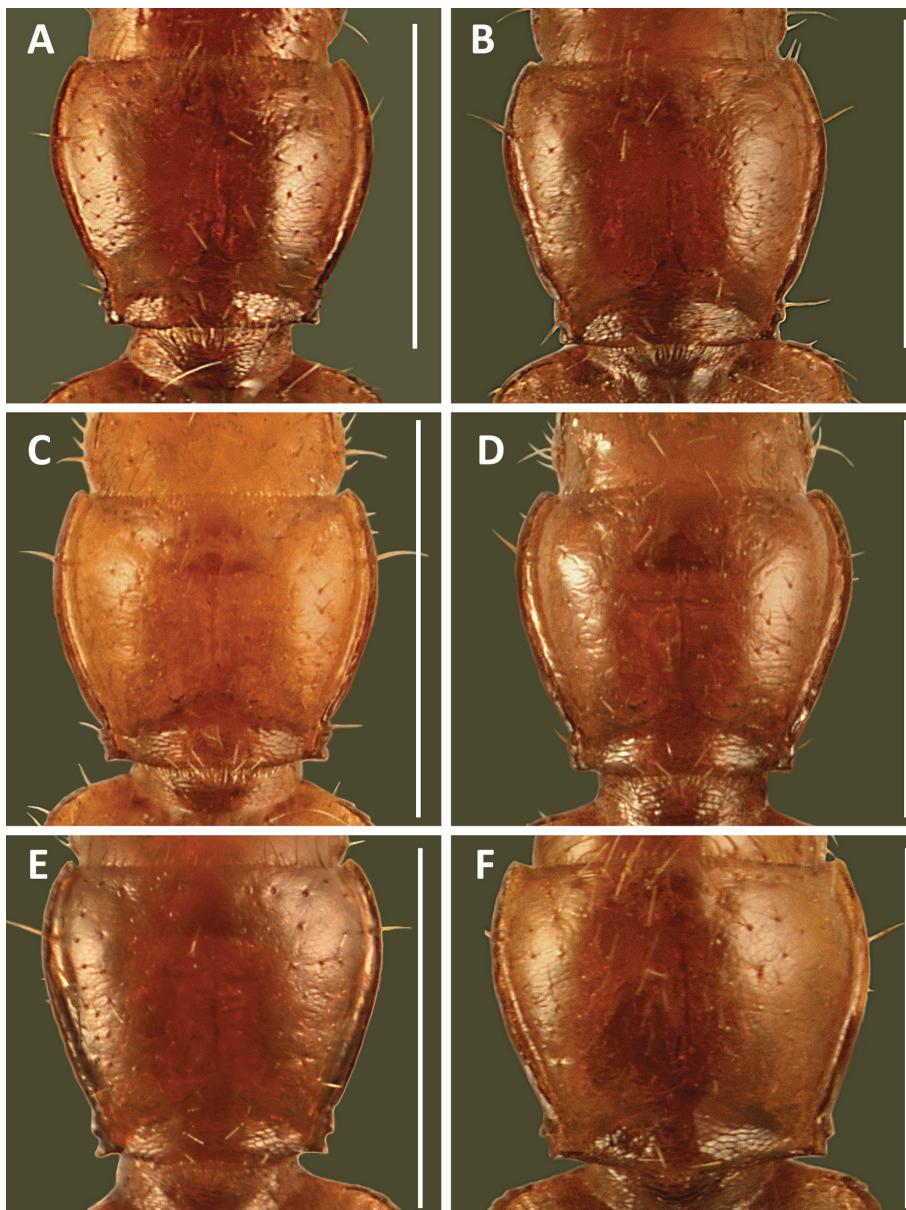


FIGURE 6. Digital images of pronota of *Pelodiaetodes* species. **A** *P. prominens* (NZ, Northland, Waipoua Forest); **B** *P. constricticollis* (NZ, Northland, Radar Bush), paratype; **C** *P. moorei* (NZ, Northland, Poor Knight Islands), paratype; **D** *P. moorei* (NZ, Northland, Puketi Forest); **E** *P. aldermensis* (NZ, Waikato, Aldermen Islands), paratype; **F** *P. nunni* (NZ, Otago, Oamaru), paratype. Scale bars = 0.5mm.

Pterothorax. Metaventrite short, distance between meso- and metacoxae about 0.5–0.8 diameter of mesocoxa. Metanepisternum short, subquadrate, with anterior and outer margins of equal length. Metendoventrite cross-shaped with lateral arms.

Legs (Fig. 3). Legs of moderate length, not elongate. Prothoracic legs of males with first 2 tarsomeres (ta1–2) markedly dilated apico-laterally with two rows of oval articulo-setae (as) (Stork 1980) on the ventral surface (Fig. 3B). Protibiae (Fig. 3C–D) with antenna cleaner of type B (Hlavac 1971), with both anterior (asr) and posterior (psr) apical setal rows and concave apico-lateral notch. Length of anterior spur (asp) equal to length of the 1st tarsomere (ta1). Profemora moderately swollen. Mesotibiae (Fig. 3E–H) with 1–2 rows of modified posterodorsal setae (msms) at apical half, with two terminal spurs (mss) and tibial brush (msb). Metafemora unmodified, metatibiae (Fig. 3I–L) with row of modified posterodorsal setae (mtms) in apical half, with two terminal spurs (mts) and tibial brush (mtb). Tarsi pentamerous (Fig. 3A–B), last and 1st tarsomeres are the longest, 2–4 tarsomeres of equal length on the tarsi of all legs, 1st tarsomere shorter than combined length of 2–4 tarsomeres. Tarsal claws simple, untoothed (Fig. 3A–B).

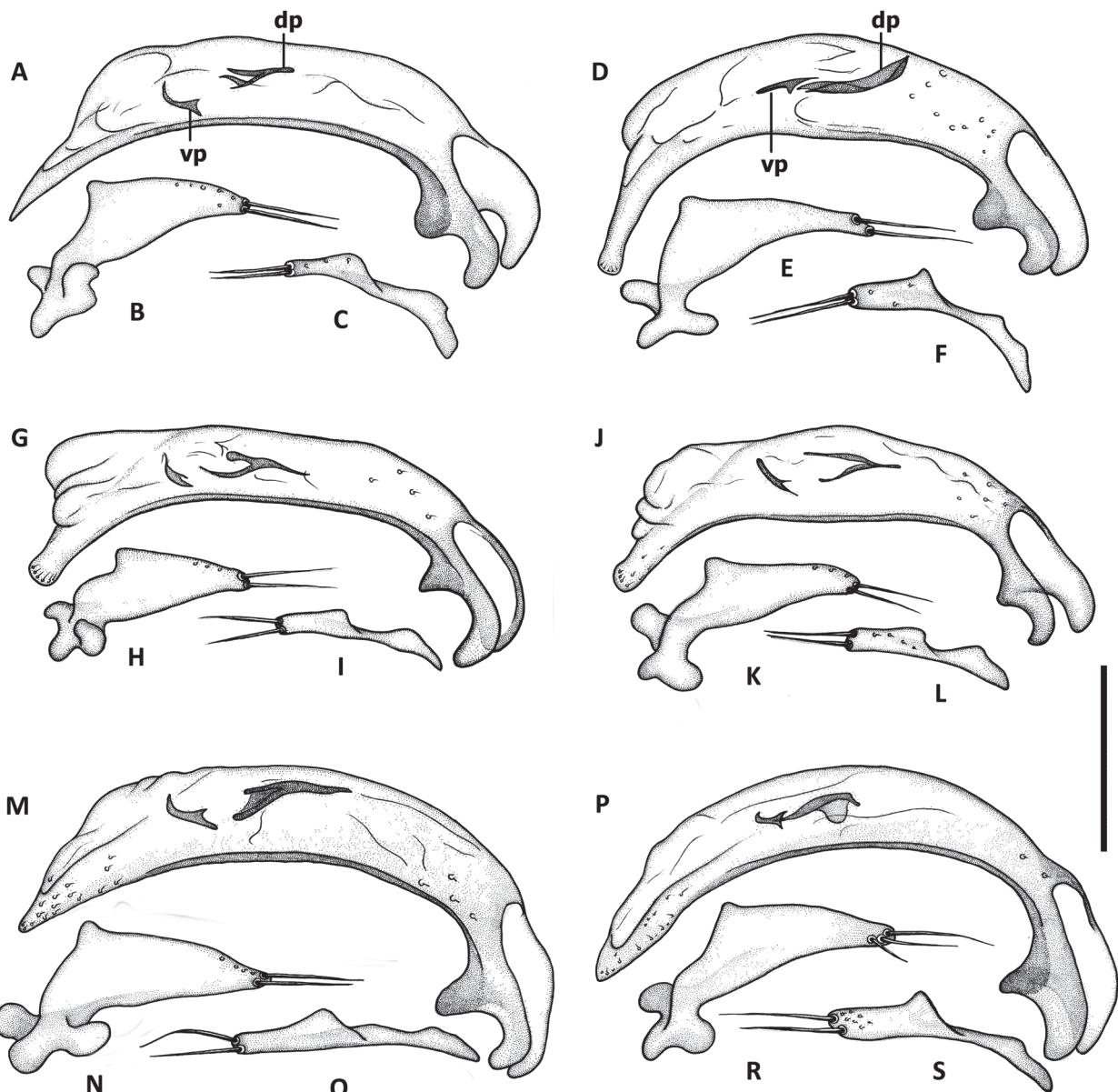


FIGURE 7. Line drawings of male aedeagus of *Pelodiaetodes* species. *P. prominens* (NZ, Northland, Omahuta Forest): **A** median lobe, right lateral aspect; **B** left paramere, left lateral aspect; **C** right paramere, right lateral aspect. *P. constricticollis* (NZ, Northland, Radar Bush): **D** median lobe, right lateral aspect; **E** left paramere, left lateral aspect; **F** right paramere, right lateral aspect. *P. moorei* (NZ, Northland, Poor Knight Islands): **G** median lobe, right lateral aspect; **H** left paramere, left lateral aspect; **I** right paramere, right lateral aspect. *P. moorei* (NZ, Northland, Puketi Forest): **J** median lobe, right lateral aspect; **K** left paramere, left lateral aspect; **L** right paramere, right lateral aspect. *P. aldermensis* (NZ, Waikato, Aldermen Islands): **M** median lobe, right lateral aspect; **N** left paramere, left lateral aspect; **O** right paramere, right lateral aspect. *P. nunni* (NZ, Otago, Oamaru): **P** median lobe, right lateral aspect; **R** left paramere, left lateral aspect; **S** right paramere, right lateral aspect. Legend: dp—dorsal plate; vp—ventral plate. Scale bar = 0.1mm.

Abdominal ventrites. Five visible abdominal ventrites: 2nd ventrite longest, 2.5–3 times longer than 3rd or 4th, 3rd and 4th equal in length; the last, 5th, 1.3–1.6 times longer than 4th. Intercoxal process of 2nd ventrite broad, subparallel, conically rounded anteriorly.

Male genitalia (Fig. 7–8). Median lobe of aedeagus anopic, elongate, slightly twisted and moderately arcuate. Internal sac with two copulatory sclerites, representing by dorsal and ventral plates. Dorsal plate (dp) in form of a stick-like plate, bifurcating or not apically. Ventral plate (vp) much smaller than dorsal plate, claw-like, bifid basally. Additional spines or scaled membranous fields of internal sac are absent. Parameres typically bisetose, except left paramere of *P. nunni* 3-setose (Fig. 7R). Left paramere large and broad evenly tapered to apex, right paramere short. Ring sclerite triangular with trianguloid handle-like extension (hd) of similar shape among species.

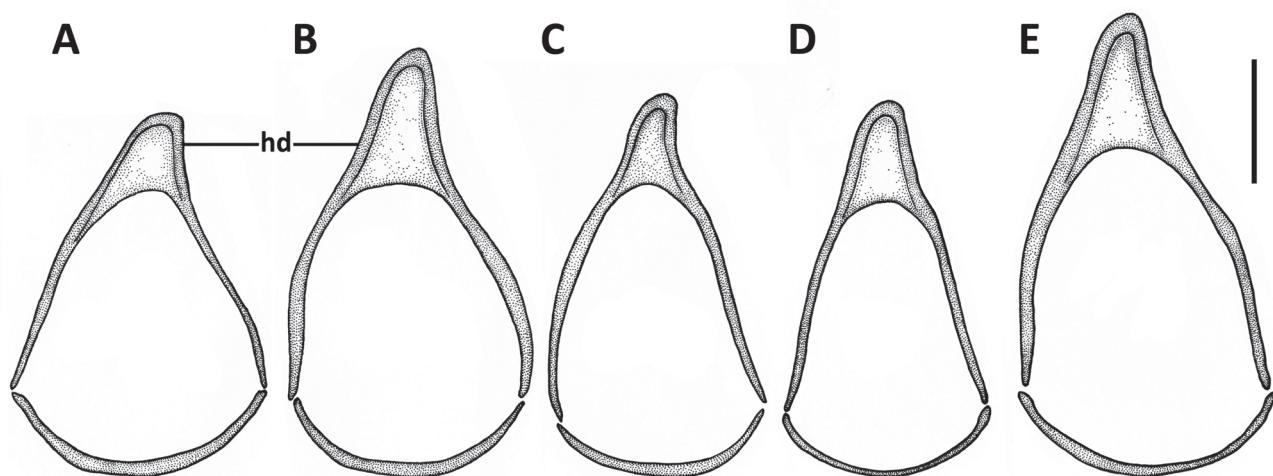


FIGURE 8. Line drawings of ring sclerite of *Pelodiaetodes* species, male genitalia, dorsal aspect. **A** *P. prominens* (NZ, Northland, Omahuta Forest). **B** *P. constricticollis* (NZ, Northland, Radar Bush). **C** *P. aldermensis* (NZ, Waikato, Aldermen Islands). **D** *P. moorei* (NZ, Northland, Poor Knight Islands). **E** *P. nunni* (NZ, Otago, Oamaru). Legend: hd—handle of ring sclerite. Scale bar = 0.1mm.

Female internal genitalia (Fig. 9–10). Gonocoxite 1 setose (gc1). Gonocoxite 2 falciform (gc2), 1.6–1.8 times longer than its basal width, moderately curved, with medial basal ridge (mbr), and with medial (mes) and lateral (les) ensiform and apical nematiform (ns) setae. Shape of medial basal ridge and length of ensiform setae vary among species. Laterotergite (lt) with 8–11 setae. Spermatheca (sp) sclerotized, small, rufous, subparallel, either with enlarged basal half or almost spherical.

Included taxa. The genus comprises two subgenera and five species: nominotypical subgenus includes *P. prominens* Moore, *P. moorei*, sp. n., *P. constricticollis*, sp. n., *P. aldermensis*, sp. n., and subgenus *Monosetodes*, subgen.n., includes *P. nunni*, sp. n.

Geographical distribution. The species of this genus are known from two widely separated regions of New Zealand (Fig. 11). Species of the *Pelodiaetodes* s.str. inhabit the northern half of the North Island, while the only representative of the subgenus *Monosetodes* is known from a single locality in the southern part of the South Island.

Way of life. According to the label information, specimens of *Pelodiaetodes* were taken either from the leaf litter or from the washed soil samples in broadleaf and kauri forests, from the litter of a shearwater colony (Aves, Procellariidae, *Puffinus bulweri*), from decayed or rotten wood, and from mosses at tree bases and on the ground. Collecting dates are August, September, October, November, December, January and April.

Relationships. Morphologically, the putative closest relative of *Pelodiaetodes* among the New Zealand anillines is *Pelodiaetus*. Both genera share developed fronto-lateral carinae, cordiform shape of pronotum and distinct longitudinal elytral groove, distinguishing them by the combination of these characters from any other New Zealand Anillina. Compared with other Anillina the members of *Pelodiaetodes* (and *Pelodiaetus*) differ from Australian *Illaphanus* and Madagascan *Bulirschia* and *Malagasytyphlus* by the presence of a mental tooth, thus formally belonging to another aniline assemblage *sensu* Jeannel (1963). But subsequent authors showed the low taxonomic value of the mental tooth at a suprageneric level and the usefulness of this character only for generic discrimination (Sciaky & Zaballos 1993; Zaballos & Casale 1997; Giachino 2005; Giachino & Vailati 2011). According Giachino (2008) the closest morphological relative to the New Zealand Anillina with grooved elytra might be the Madagascan *Malagasydipnus*. Species of the latter genus share with the members of *Pelodiaetodes* and *Pelodiaetus* such characters as (i) presence of the mental tooth; (ii) cordiform pronotum with distinct posterior angles, but without denticles in front of them; (iii) three discal elytral setae; (iv) two dilated protarsomeres in males; (v) and two, flagelliform and falciform, structures in the inner sac of median lobe. Nevertheless, the position of *Pelodiaetodes* within the group of Anillina with grooved elytra remain unclear at present, and awaits molecular data phylogenetic analysis along with thorough morphological phylogenetic analysis of the entire group.

The key provided below allows identification of males of *Pelodiaetodes*, including separation from all other New Zealand aniline genera. Females of *Pelodiaetodes* can be identified only by distributional information, preferably by association with microsympatric males.

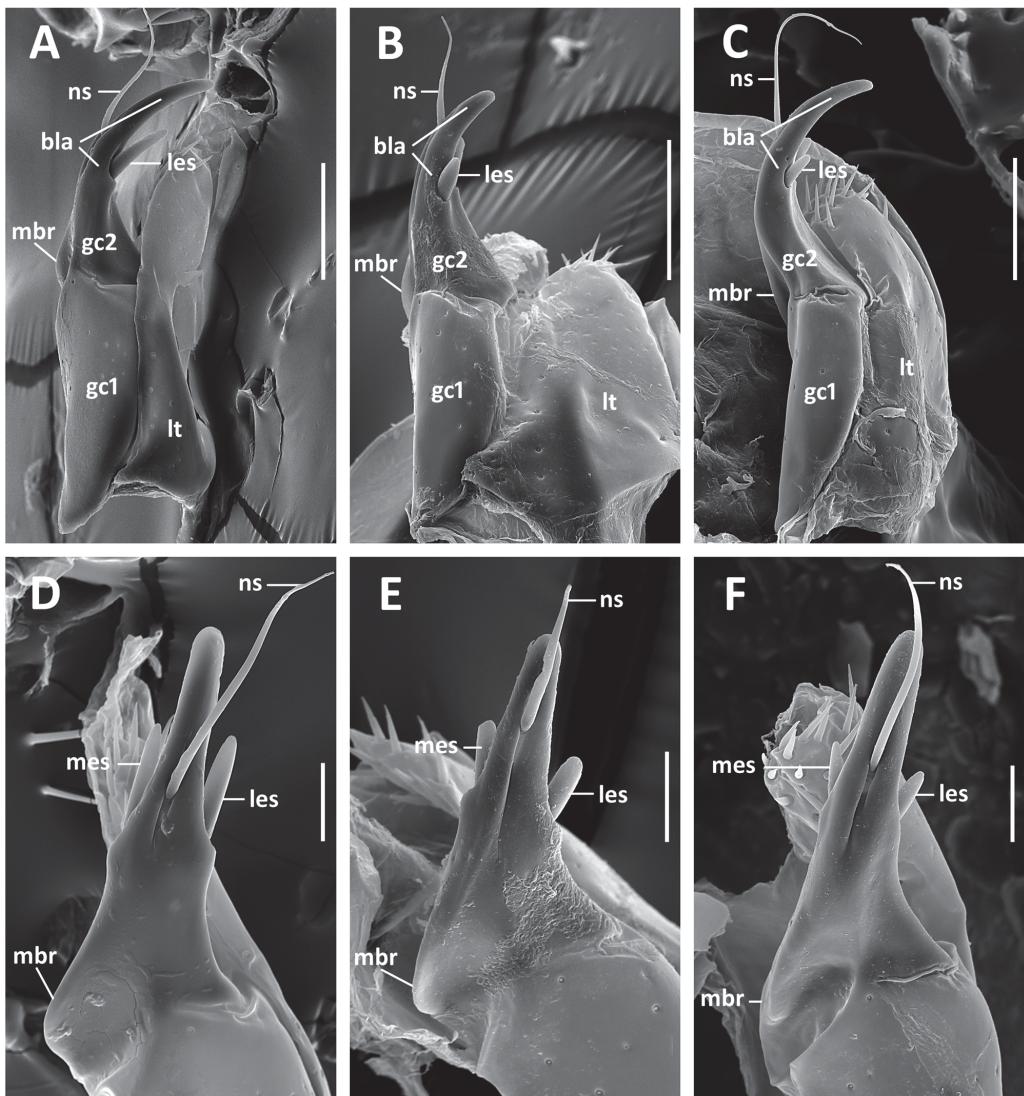


FIGURE 9. SEM illustrations of ovipositor sclerites of *Pelodiaetodes* species. **A–B** right ovipositor sclerite, lateral aspect; **C–D** right gonocoxite 2, ventral aspect. **A, D** *P. prominens*; **B, E** *P. moorei*; **C, F** *P. nunnii*. Legend: mbr—medial basal ridge of gonocoxite 2; bla—blade of gonocoxite 2; les—lateral ensiform seta; gc1—gonocoxite 1; gc2—gonocoxite 2; lt—laterotergite; mes—medial ensiform seta; ns—nematiform seta. Scale bars: A–C = 0.05mm; D–F = 0.02mm.

Key to species of *Pelodiaetodes* from New Zealand based on males

1. Pronotum with distinct sinuation laterobasally and short subparallel basal constriction 2
- Lateral sides of pronotum not sinuate basally, pronotum without subparallel basal constriction (genera *Zeanillus* Jeannel, *Nesamblyops* Jeannel)
2. Head with obliterated fronto-lateral carinae. Elytra lacking longitudinal grooves *Hygraniellus* Moore
- Head with long and distinct fronto-lateral carinae. Elytra with longitudinal grooves 3
3. Basal constriction of pronotum with distinct tubercle, bearing basolateral pronotal seta, anterior to the posterior angles 4
- Basal constriction of pronotum without tubercles or denticles anterior to the posterior angles *Pelodiaetus* Jeannel
4. With 1 elytral discal seta (Fig. 2D, ed6). Pronotum moderately constricted basally ($Wa/Wp < 1.20$; $Wm/Wp < 1.40$). Beetles from South Island *Pelodiaetodes (Monosetodes) nunnii*, sp. n.
- With 3 elytral discal setae (Fig. 2C, ed3, ed5–6). Pronotum strongly constricted basally ($Wa/Wp > 1.20$; $Wm/Wp > 1.40$). Beetles from North Island 5
5. Apex of median lobe subparallel and rounded at tip (Fig. 7D, G, J) 6
- Apex of median lobe tapering and pointed at tip (Fig. 7A, M) 7
6. Pronotum (Fig. 6B) more elongate ($Wm/Le < 1.15$). Beetles larger (1.67–1.76mm). Range to the north of 34.6°S latitude *Pelodiaetodes (s.str.) constricticollis*, sp. n.

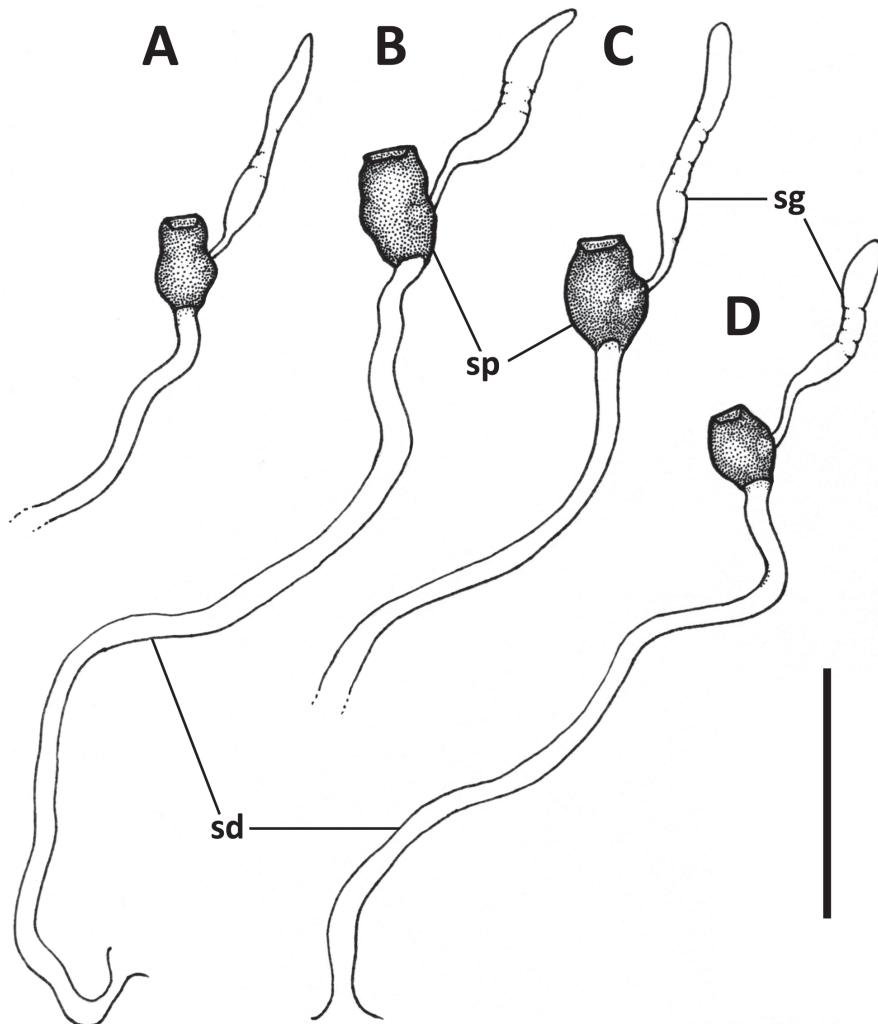


FIGURE 10. Line drawings of spermatheca, spermathecal duct, and spermathecal gland of *Pelodiaetodes* species. **A** *P. prominens* (NZ, Northland, Waipoua Forest). **B** *P. moorei* (NZ, Northland, Poor Knight Islands). **C** *P. aldermensis* (NZ, Waikato, Aldermen Islands). **D** *P. nunnii* (NZ, Otago, Oamaru). Legend: sd—spermathecal duct; sg—spermathecal gland; sp—spermatheca. Scale bar = 0.05mm.

- Pronotum (Fig. 6C–D) more transverse ($Wm/Le > 1.15$). Beetles smaller (1.18–1.51mm). Range to the south of 35°S latitude. *Pelodiaetodes* (s.str.) *moorei*, sp. n.
- 7. Apex of median lobe less tapering with acute tip (Fig. 7M). Island endemic from the east of New Zealand (Aldermen Islands) *Pelodiaetodes* (s.str.) *aldermensis*, sp. n.
- Apex of median lobe more tapering with acuminate tip (Fig. 7A). Mainland species from the west coast of New Zealand *Pelodiaetodes* (s.str.) *prominens* Moore

Pelodiaetodes (*sensu stricto*)

Pelodiaetodes Moore 1980: 404 (type species *Pelodiatus prominens* Moore 1980, by original designation).

Recognition. With character states of genus *Pelodiaetodes*, restricted as follows: 3 discal setae on elytra, narrow base of pronotum ($WPa/WPp > 1.20$), bisetose left paramere in males, pronounced medial basal ridge of gonocoxite 2 and elongate spermatheca in females.

Included taxa. This subgenus includes four taxa: *P. aldermensis*, *P. constricticollis*, *P. moorei*, *P. prominens*.

Geographical distribution. The range of subgenus is confined to the northern part of the North Island, approximately north of 37° S latitude.

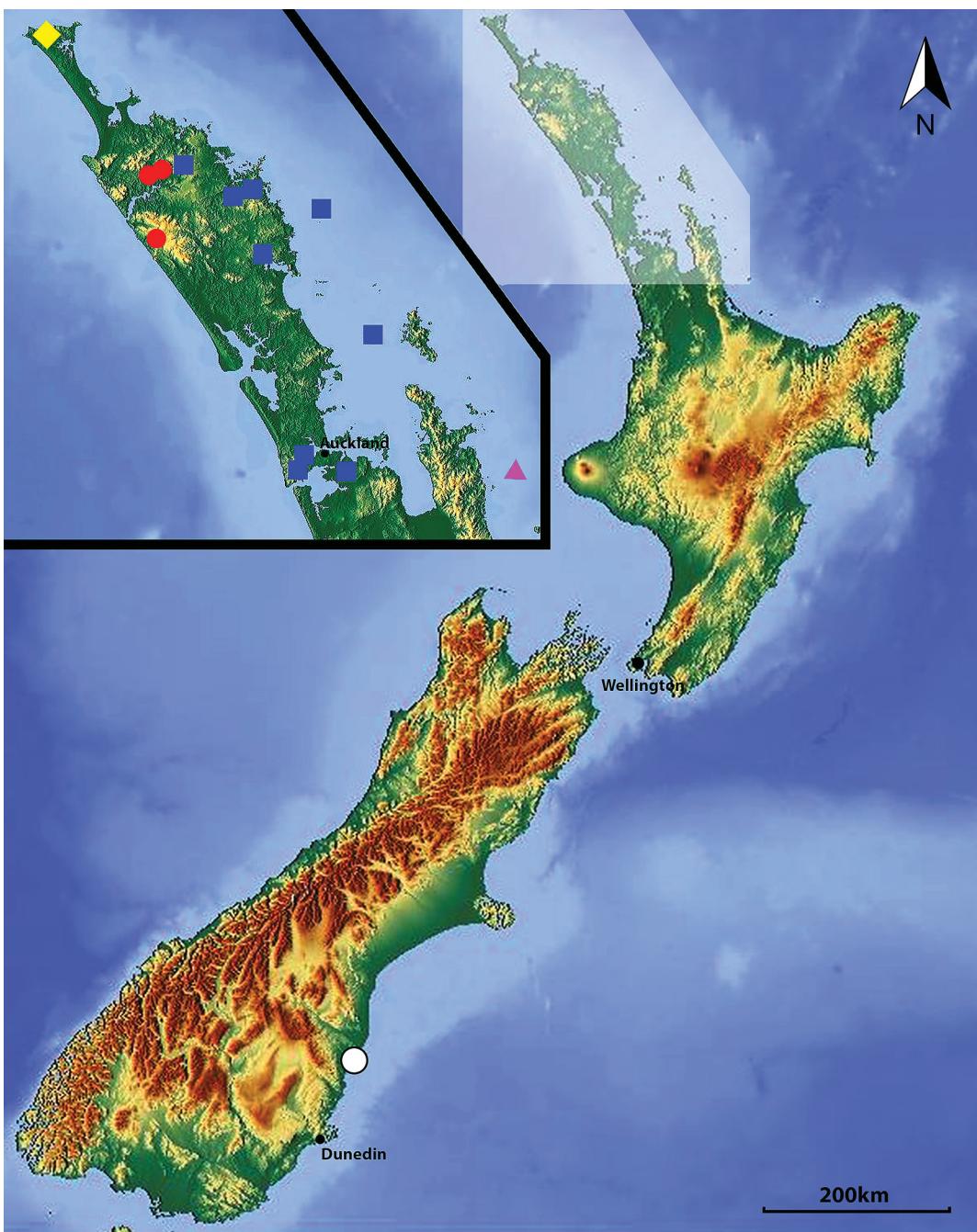


FIGURE 11. Map of New Zealand, showing positions of locality records for *Pelodiaetodes* species: *P. prominens*—red circles; *P. constricticollis*—yellow diamond; *P. moorei*—blue quadrangles; *P. aldermensis*—pink triangle; *P. numni*—white circle.

Relationships. Supposedly this subgenus is a sister, less derived, taxon of the subgenus *Monosetodes*, described below, widely isolated from the latter geographically (by the Cook Strait and by vast territories of the North and South Islands).

***Pelodiaetodes aldermensis*, sp. n.**

Figs. 3BDFJ, 5C, 6E, 7M–O, 8C, 10C, 11

Type material. HOLOTYPE, male, in NZAC, point-mounted, dissected, labeled: \ Ruamahuati I. Aldermen Is. CL 12 Nov. 72 G.W. Ramsay \ Litter 72/202 \ Entomology Division D.S.I.R. New Zealand \ *Pelodiaetodes prominens* det.B.P. Moore\ N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \.

PARATYPES (5 examples, 4 exx. dissected), 3 males and 1 female labeled same as holotype; 1 female labeled: \ Hongiora I. Aldermen Is. CL 11 Nov. 72 D.Merton \ Litter 72/194 \ Entomology Division D.S.I.R. New Zealand \ *Pelodiaetodes prominens* det.B.P. Moore \ N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \.

Specific epithet. The specific epithet is a Latinized adjective in the masculine form based on the name of the Aldermen Islands, from which the new species is described.

Type locality. New Zealand, North Island, Coromandel, Aldermen Islands.

Recognition. Externally, adults of this species (Fig. 5C) are practically indistinguishable from the adults of *P. prominens* and *P. constricticollis*, described below, but males of *P. aldermensis* are distinguished from the males of the latter and other congeners by the structure of the median lobe.

Description. Size. Medium- to large-sized for genus (SBL range 1.52–1.80 mm, mean 1.63 ± 0.103 mm, n=5).

Habitus. Body form subdepressed, subparallel, markedly elongate (WE/SBL 0.37 ± 0.014), head large for genus compared to pronotum (WH/WPm 0.81 ± 0.023), pronotum narrow in comparison to elytra (WPm/WE 0.76 ± 0.033).

Color. Body color brunneorufous, appendages testaceous.

Prothorax. Pronotum (Fig. 6E) moderately long (LP/LE 0.44 ± 0.012) and moderately elongate (WPm/LP 1.20 ± 0.052), with lateral margins shallowly sinuate and markedly constricted posteriorly (WPm/WPp 1.51 ± 0.070). Anterior angles prominent, posterior angles slightly obtuse (110 – 120 °). Width between anterior angles much greater than between posterior angles (WPa/WPp 1.22 ± 0.043).

Elytra. Moderately depressed along suture, comparatively short (LE/SBL 0.54 ± 0.016) and moderately wide (WE/LE 0.69 ± 0.025), without traces of striae. Humeri distinct, rounded, in outline forming obtuse angle with longitudinal axis of body. Lateral margins subparallel, slightly divergent at basal half, evenly rounded to apex in apical half.

Male genitalia. Median lobe (Fig. 7M) with long shaft, arcuate ventral margin and elongate apex with acute tip. Sclerites of internal sac remote from each other, the dorsal sclerite bifurcated apically, markedly longer than ventral sclerite. Left paramere with short and conical apical constriction (Fig. 7N). Ring sclerite with slightly long and slightly asymmetrical handle, narrowly rounded at tip (Fig. 8C).

Female internal genitalia. Gonoxite 2 with prominent medial basal ridge and long ensiform setae. Spermatheca weakly sclerotized, elongate, of pot shape with enlarged basal half (Fig. 10C). Length of spermathecal gland much greater than length of spermatheca. Spermathecal duct slightly wavy and very long.

Geographical distribution. This species is known only from the Aldermen group of islets, namely Ruamahuaiti and Hongiora islets, located off the coast of the Coromandel Peninsula in the North Island (Fig. 11, pink triangle).

Way of life. This species has been collected in litter, without precise indication of the type of vegetation.

Relationships. The acute tip of the median lobe of the aedeagus is similar to that of males of *P. prominens*.

Pelodiaetodes constricticollis, sp. n.

Figs. 5B, 6B, 7D–F, 8B, 11

Type material. HOLOTYPE, male, in NZAC, point-mounted, dissected, labeled: \ New Zealand ND Radar Bush Te Paki 4.12.95 \ in soil and litter, kauri forest \.

PARATYPES (1 example, dissected), 1 male labeled same as holotype.

Specific epithet. The specific epithet is a Latinized adjective in the masculine form and is derived from the Latin adjective *constrictus* meaning "contracted, compressed" and the Latin noun *collum* meaning "neck, stem". The epithet refers to the shape of strongly constricted pronotum of the new species.

Type locality. New Zealand, North Island, Northland, Te Paki, Radar Bush.

Recognition. Adults of this species (Fig. 5B) are practically indistinguishable from the adults of *P. prominens* and *P. aldermensis*, described above, and males of *P. constricticollis* are distinguished from the males of the latter and other congeners by the structure of the median lobe.

Description. Size. Large-sized for genus (SBL range 1.67–1.76 mm, mean 1.72 ± 0.064 mm, n=2).

Habitus. Body form subdepressed, subparallel, markedly elongate (WE/SBL 0.35 ± 0.016), head large for genus compared to pronotum (WH/WPm 0.81 ± 0.016), pronotum of moderate width in comparison to elytra (WPm/WE 0.78 ± 0.006).

Color. Body color brunneorufous, appendages testaceous.

Prothorax. Pronotum (Fig. 6B) moderately long (LP/LE 0.46 ± 0.024) and markedly elongate (WPm/LP 1.13 ± 0.008), with lateral margins shallowly sinuate and markedly constricted posteriorly (WPm/WPp 1.50 ± 0.046). Anterior angles prominent, posterior angles nearly rectangular ($100\text{--}110^\circ$). Width between anterior angles much greater than between posterior angles (WPa/WPp 1.23 ± 0.035).

Elytra. Moderately depressed along suture, comparatively short (LE/SBL 0.52 ± 0.011) and narrow (WE/LE 0.67 ± 0.045), without traces of striae. Humeri distinct, rounded, in outline forming obtuse angle with longitudinal axis of body. Lateral margins subparallel, slightly divergent at basal half, evenly rounded to apex in apical half.

Male genitalia. Median lobe (Fig. 7D) with long shaft, almost straight ventral margin and markedly elongate apex with rounded tip. Sclerites of internal sac close to each other, the dorsal sclerite of stylet-like shape, slightly curved ventrally. Left paramere with long and subparallel apical constriction (Fig. 7E). Ring sclerite with moderately long, slightly asymmetrical handle, narrowly rounded at tip (Fig. 8B).

Female unknown.

Geographical distribution. This species is known only from Radar Bush (Te Paki Ecological District, Northland, North Island) (Fig. 11, yellow diamond).

Way of life. This species has been found in soil and litter of kauri (*Agathis australis* (D. Don) Loudon) forest.

Relationships. The rounded tip of the median lobe of males resembles that of *P. moorei*, described below. *Pelodiaetodes constricticollis* differs from that species in being larger and darker in color.

Pelodiaetodes moorei, sp. n.

Figs. 3GK, 5D–E, 6C–D, 7G–L, 8D, 9BE, 10B, 11

Type material. HOLOTYPE, male, in NZAC, point-mounted, labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi 5 Dec 1980 G. Kuschel \ sifted litter and decayed wood 80/137\N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \.

PARATYPES (28 examples, 6 exx. dissected), 1 male and 1 female labeled same as holotype; 6 females labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi 1 Dec 1980 G. Kuschel \ sifted litter and rotten wood 80/130 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 1 male and 1 female labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi 2 Dec 1980 G. Kuschel \ sifted litter 80/129 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 2 females labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi 4 Dec 1980 G. Kuschel \ sifted litter 80/133 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 1 female labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi 4 Dec 1980 G. Kuschel \ sifted litter from *Puffinus bulieri* colony 80/133 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 1 female labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi 6 Dec 1980 G. Kuschel \ sifted rotten wood 80/140 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 2 males and 2 females labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi 8 Dec 1980 G. Kuschel \ sifted litter 80/143 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 1 male labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi, 200m 10 Sep 1980 \ J.C. Watt Litter 80/68 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 1 male labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi Smt Plateau, 200m 10 Sep 1980 \ 11 Sep 1980 J.C. Watt Litter 80/69 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 2 males and 1 female labeled: \ New Zealand ND Poor Knights Is Tawhiti Rahi, E side of Summit Plateau, 170m \ 11 Sep 1980 J.C. Watt Litter 80/71 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 1 male and 2 females labeled: \ ex forest litter Tawhitirahi Poor Knights Is 10 Aug 1970 B.M. May \ Entomology Division D.S.I.R. New Zealand \ *Pelodiaetodes prominens* det.B.P. Moore \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 1 male labeled: \ New Zealand ND Poor Knights Is Aorangi, ridge NE Oneho Hill 13 Nov 1981 \ J.C. Watt Litter and woodmould 81/129 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \; 1 male labeled: \ New Zealand ND Poor Knights Is Aorangi 17 Nov 1981 \ J.S. Dugdale Soil 81/142 \N.Z. Arthropod Collection, NZAC Private Bag 92170 Auckland New Zealand \.

Additional material. Northland (15 examples, 4 exx. dissected): Puketi State Forest; Russel State Forest; Waiorio Bush, Kawakawa; Mair Park, Whangarei; Parahaki Park, Whangarei.

Auckland (4 examples, 2 exx. dissected): Cascades; Oratia; Huapai; Little Barrier Pohutukawa Flat.

Specific epithet. The specific epithet is a Latinized eponym in the genitive case, and is based on the surname of B. P. Moore, the first reviser of the species of *Anillina* of New Zealand.

Type locality. New Zealand, North Island, Northland, Poor Knights Islands.

Recognition. Adults of this species (Fig. 5D–E) are practically indistinguishable externally from the adults of other congeners, except the smaller size and lighter color, and males of *P. moorei* are distinguished from the males of other congeners by the structure of the median lobe.

Description. Size. Small- to medium-sized for genus (SBL range 1.18–1.50 mm, mean 1.38 ± 0.089 mm, $n=21$).

Habitus. Body form subdepressed, subparallel, markedly elongate (WE/SBL 0.36 ± 0.013), head large for genus compared to pronotum (WH/WPm 0.80 ± 0.018), pronotum of moderate width in comparison to elytra (WPm/WE 0.79 ± 0.024).

Color. Body color rufotestaceous, appendages testaceous.

Prothorax. Pronotum (Fig. 6C–D) moderately long (LP/LE 0.45 ± 0.018) and moderately elongate (WPm/LP 1.19 ± 0.053), with lateral margins shallowly sinuate and markedly constricted posteriorly (WPm/WPp 1.51 ± 0.036). Anterior angles prominent, posterior angles almost rectangular (90 – 110°). Width between anterior angles much greater than between posterior angles (WPa/WPp 1.22 ± 0.036).

Elytra. Moderately depressed along suture, comparatively short (LE/SBL 0.54 ± 0.014) and narrow (WE/LE 0.67 ± 0.022), without traces of striae. Humeri distinct, rounded, in outline forming obtuse angle with longitudinal axis of body. Lateral margins subparallel, slightly divergent at basal half, evenly rounded to apex in apical half.

Male genitalia. Median lobe (Fig. 7G–J) with long shaft, almost straight ventral margin and elongate apex with rounded tip. Sclerites of internal sac remote from each other, the dorsal sclerite bifurcated apically, markedly longer than ventral sclerite. Left paramere with short and conical apical constriction (Fig. 7H, K). Ring sclerite with moderately long, almost symmetrical handle, narrowly rounded at tip (Fig. 8D).

Female internal genitalia. Gonocoxite 2 with prominent basal ridge and ensiform setae of moderate length (Fig. 9B, E). Spermatheca weakly sclerotized, elongate, of barrel shape (Fig. 10B). Length of spermathecal gland much greater than length of spermatheca. Spermathecal duct slightly wavy and very long.

Geographical distribution. This species is broadly distributed within the subgenus range, inhabiting the mainland of the eastern part of the Northland and entire Auckland regions, with adjacent islands off the East coast (Fig. 11, blue quadrangles).

Way of life. This species has been collected in wide range of habitats, including forest litter, decaying and rotten wood, also from the litter in shearwater colony.

Relationships. Males of this new species resemble males of *P. constricticollis*, described above, based on the rounded tip of the median lobe, but differ in other details of aedeagal structure.

Pelodiaetodes prominens Moore

Figs. 1AC, 2AC, 3EI, 4, 5A, 6A, 7A–C, 8A, 9AD, 10A, 11

Examined material. Northland (19 examples, 6 exx. dissected): Waipoua S. F.; Omahuta SF; Mangamuka Summit.

Recognition. Externally adults of this species (Fig. 5A) are indistinguishable from the adults of other congeners. Males of *P. prominens* may be distinguished from males of other congeners by the structure of the median lobe.

Description. Size. Medium- to large-sized for genus (SBL range 1.47–1.72 mm, mean 1.59 ± 0.085 mm, $n=7$).

Habitus. Body form subdepressed, subparallel, markedly elongate (WE/SBL 0.38 ± 0.009), head large for genus compared to pronotum (WH/WPm 0.79 ± 0.013), pronotum narrow in comparison to elytra (WPm/WE 0.75 ± 0.020).

Color. Body color brunneorufous, appendages testaceous.

Prothorax. Pronotum (Fig. 1C, 6A) moderately long (LP/LE 0.46 ± 0.022) and moderately elongate (WPm/LP 1.17 ± 0.031), with lateral margins shallowly sinuate and markedly constricted posteriorly (WPm/WPp 1.52 ± 0.037). Anterior angles prominent, posterior angles slightly obtuse (110 – 120°). Width between anterior angles much greater than between posterior angles (WPa/WPp 1.24 ± 0.034).

Elytra (Fig. 2C). Moderately depressed along suture, comparatively short (LE/SBL 0.53 ± 0.020) and

moderately wide (WE/LE 0.72 ± 0.036), without traces of striae. Humeri distinct, rounded, in outline forming obtuse angle with longitudinal axis of body. Lateral margins subparallel, slightly divergent at basal half, evenly rounded to apex in apical half.

Male genitalia. Median lobe (Fig. 7A) with long shaft, arcuate ventral margin and elongate apex with acuminate tip. Sclerites of internal sac remote from each other, the dorsal sclerite bifurcated apically, similar in size to ventral sclerite. Left paramere with short and conical apical constriction (Fig. 7B). Ring sclerite with short, slightly asymmetrical handle, moderately rounded at tip (Fig. 8A).

Female internal genitalia. Gonocoxite 2 with prominent medial basal ridge and long ensiform setae (Fig. 9A, D). Spermatheca weakly sclerotized, elongate, of barrel shape, with slightly enlarged basal half (Fig. 10A). Length of spermathecal gland much greater than length of spermatheca. Spermathecal duct slightly wavy and very long.

Geographical distribution. As far as known this species inhabits areas, surrounding the Hokianga Harbour, in the western part of Northland (Fig. 11, red circles).

Way of life. This species has been collected by sifting forest litter and mosses from tree bases and ground.

Relationships. Males of this new species resemble males of *P. aldermensis*, described above, based on the tapering apex of the median lobe, but differ in the shape of the apical tip and larger size of the dorsal sclerite of the internal sac of the median lobe.

***Monosetodes*, new subgenus**

Type species. *Pelodiaetodes nunni*, sp. n. (here designated).

Subgeneric name. The name of subgenus refers to the single discal elytral pore of the type species as a main diagnostic character of the taxon.

Recognition. With character states of the genus *Pelodiaetodes*, restricted as follows: one discal seta on each elytron, wide base of pronotum (WP_a/WP_p < 1.20), trisetose left paramere in males, smooth medial basal ridge and short ensiform setae of gonocoxite 2 and almost spherical spermatheca in females.

Included taxa. This subgenus includes one species, *P. nunni*.

Geographical distribution. The only representative of *Monosetodes* is known from a single locality, in Oamaru, North Otago, South Island.

Relationships. This subgenus is considered to be a more derived sister taxon of the subgenus *Pelodiaetodes*, from which it is widely separated geographically.

***Pelodiaetodes nunni*, sp. n.**

Figs. 1BD, 2BD, 3AChL, 5F, 6F, 7P–S, 8E, 9CF, 10D, 11

Type material. HOLOTYPE, male, in NZAC, point-mounted, dissected, labeled: \ New Zealand DN Roy Cooper Res Oamaru 2 Aug 07 \ Washed soil sample, broadleaf forest \.

PARATYPES (29 examples, 5 exx. dissected), 5 males and 23 females labeled same as holotype; 1 female labeled: \ New Zealand DN Glen Warren Res Oamaru 19 Jan 07 \ Washed soil sample\.

Specific epithet. The specific epithet is a Latinized eponym in the genitive case, and is based on the surname of John T. Nunn, the collector of this species.

Type locality. New Zealand, South Island, Dunedin, Oamaru, Glen Warren Reserve (=Roy Cooper Reserve, another name used for the same area).

Recognition. Adults of this species (Fig. 5F) are distinguished from the adults of other congeners in having only one discal pore (ed6), by the shape of pronotum, by structure of the median lobe, by the structural details of ovipositor and by almost spherical spermatheca.

Description. Size. Large-sized for genus (SBL range 1.61–1.84 mm, mean 1.73 ± 0.075 mm, n=20).

Habitus. Body form subdepressed, subparallel, moderately elongate (WE/SBL 0.34 ± 0.010), head moderately narrow for genus compared to pronotum (WH/WP_m 0.77 ± 0.015), pronotum wide in comparison to elytra (WP_m/WE 0.83 ± 0.015).

Color. Body color brunneorufous, appendages testaceous.

Prothorax. Pronotum (Fig. 1D, 6F) moderately long (LP/LE 0.43 ± 0.021) and moderately elongate (WPm/LP 1.23 ± 0.040), with lateral margins shallowly sinuate and moderately constricted posteriorly (WPm/WPp 1.37 ± 0.023). Anterior angles prominent, posterior angles slightly obtuse ($110\text{--}120^\circ$). Posterior margin wide, width between anterior angles moderately greater than between posterior angles (WPa/WPp 1.15 ± 0.032).

Elytra (Fig. 2D). Moderately depressed along suture, comparatively short (LE/SBL 0.53 ± 0.014) and narrow (WE/LE 0.64 ± 0.021), without traces of striae. Humeri distinct, rounded, in outline forming obtuse angle with longitudinal axis of body. Lateral margins subparallel, slightly divergent at basal half, evenly rounded to apex in apical half.

Male genitalia. Median lobe (Fig. 7P) with long shaft, arcuate ventral margin and short, slightly enlarged ventrally, apex with tapering, narrowly rounded, tip. Sclerites of internal sac adjoin to each other, the dorsal sclerite stylet-like, with ventral enlargement, markedly longer than ventral sclerite. Left paramere with short and conical apical constriction (Fig. 7R). Ring sclerite with moderately long, almost symmetrical handle, narrowly rounded at tip (Fig. 8E).

Female internal genitalia. Gonocoxite 2 with medial basal ridge smooth, and ensiform setae short (Fig. 9C, F). Spermatheca smaller than in other congeners, almost spherical, only slightly elongate (Fig. 10D). Length of spermathecal gland much greater than length of spermatheca. Spermathecal duct slightly wavy and very long.

Geographical distribution. This species is known only from a single locality, Glen Warren Reserve (= Roy Cooper Reserve) in Oamaru, South Island (Fig. 11, white circle).

Way of life. This species has been collected in the broadleaf forest, by using a soil washing technique.

Relationships. This species resembles its congeners from the North Island based on presence of an auxiliary tubercle anterior to the posterior angles of pronotum and in the structure of the median lobe. The small and rounded spermatheca is similar to that of females of *Pelodiaetus sulcatipennis* Jeannel.

Discussion

A thorough phylogenetic analysis of *Pelodiaetodes* will be postponed until an adequate revision of all species of the New Zealand anillines or at least of the representatives of *Pelodiaetus*, another genus whose members have grooved elytra, has been completed. In the following discussion I point out only a few biogeographical issues, raised during the morphological and distributional studies of the *Pelodiaetodes* species and their relatives.

The distributions of representatives of the genus under consideration are confined to two regions of New Zealand. The range of the species belonging to the nominative subgenus is restricted to the Northland, Auckland, and Waikato regions of the North Island, while the single representative of the subgenus *Monosetodes* is known only from the North Otago region of the South Island. Basically, the northern range of the genus corresponds to the forest refugia on the North Island during the Last Glacial Maximum (e.g., Alloway *et al.* 2007). Geologically, the northern range of the genus is associated mostly with the Northern Allochthon, a formation that originated from the Three Kings Ridge complex to the north of New Zealand (Bradshaw 2004). The southern range of the genus, in particular the Oamaru area, is associated with the Rakaia Terrane, which was formed from the Antarctic sector of the Panthalassan margin of Gondwana (Wandres *et al.* 2004). Both territories, the Northern Allochthon and Rakaia Terrane, are treated as comparatively newer terrestrial areas that presumably became subaerial only after New Zealand's breakup from Gondwana (Landis *et al.* 2008). By contrast, some other terranes, are considered to be older or of Gondwanan age and may never have been submerged (Liebherr *et al.* 2011). *Pelodiaetodes nunni* and three of the species from the northern part of the range inhabit the mainland, and *P. moorei* is also known to be from the islands adjacent to the mainland. The fourth species from the northern range, *P. aldermensis*, is an exclusive island endemic. None of the species of the genus are known to have been collected together, which implies that allopatric speciation was the main factor in shaping species diversity. From these five species, *P. nunni* from the South Island and, *P. constricticollis* from the North Island are known from single localities. Two other northern species, *P. aldermensis* and *P. prominens*, are known from more than one locality but are limited in their distribution either by island group or by specific coastal area, respectively. Only one species of the genus, *P. moorei*, is widely distributed across the eastern part of the Northland and Auckland regions, inhabiting both mainland and adjacent islands and thus occurring on areas underlain by geological terranes of disparate origin.

In the treatment of New Zealand carabids from the tribe Broscini, Liebherr *et al.* (2011) have defined "post-

Gondwanan" taxa as those which colonized New Zealand across the Tasman Sea subsequent to the Cretaceous vicariance of New Zealand and Australia. According to the authors, these taxa demonstrate the following patterns of distribution and diversification in New Zealand: abundant endemism in Northland and the islands and peninsulas of the North Island, definite restriction in geographic distribution to areas underlain by the youngest geological terranes, and exhibition of widespread geographic distributions spanning geological terranes of disparate ages (I.c.). The pattern of distribution of the representatives of *Pelodiaetodes* includes: (i) restriction to areas underlain by the youngest geological terranes and, (ii) an area of diversification, located mostly in Northland, is consistent with the characteristics proposed by Liebherr *et al.* (2011), and, correspondingly, indicative of post-Gondwanan, i.e. northern (Australian or New Caledonian) origin of the genus. The existence of the representative of Anillina with grooved elytra in Australia (genus *Illaphanus* from New South Wales) (Giachino 2005), and absence of Anillina with grooved elytra recorded from New Caledonia to date, supports the hypothesis regarding the Australian origin of *Pelodiaetodes*. New Zealand carabids with their highest diversity in the Northland region include the moriomorphine genus *Meonochilus* Liebherr and Marris (Liebherr 2011) and broscine genus *Mecodema* Blanchard (Seldon & Leschen 2011), both of which have sister groups in Australia. Within the context of this approach, *Pelodiaetus*, the other New Zealand genus with grooved elytra, from the southern portion of the South Island (Moore 1980) and Stewart Island (I.S., unpubl.data) (both underlain by Gondwanan Buller and Takaka, Brook Street Terranes, etc.) (Liebherr *et al.* 2011), should be treated as a Gondwanan relictual taxon.

Finally, it is interesting to compare the distribution pattern of Anillina with grooved elytra with those of other groups. As mentioned above, in addition to the Australian/New Zealand members the only other three genera from this morphological group, *Malagasytyphlus* Giachino, *Malagasydipnus* Giachino, and *Bulirshia* Giachino are known from Madagascar (Giachino 2008). Their relationships with the *Illaphanus-Pelodiaetus-Pelodiaetodes* complex remain obscure. The assumption that anillines from Madagascar and Australia/New Zealand are not related, and that the longitudinal groove on elytra evolved independently in these taxa seems less parsimonious, because this character is unknown among other anillines. Thus, the presence or absence of the groove on elytra is not evenly distributed among Anillina worldwide, as would be expected in the case of random occurrence of the character. Instead, this apparently derived character may have evolved only once in taxa confined to the territories of the ancient East Gondwanan continent. This common biogeographic origin implies genetic relatedness of these genera, which should be revealed through molecular phylogenetic analyses. The assumption of phylogenetic relatedness of both generic assemblages also raises questions and suggests considering the hypothetical role of vicariance versus dispersal in shaping the distributional pattern of the group.

The biogeographic history of the Southern Hemisphere is considered a prime example of vicariance, where modern distributions of austral taxa resulted from the sequential breakup of the southern supercontinent Gondwana, causing division of its ancestral biota (Sanmartin & Ronquist 2004; Sparks & Smith 2004; Turner 2004; Noonan & Chippingdale 2006). The most comprehensive biogeographical analysis of 54 non-marine animal and 19 plant groups of Gondwanan origin with Southern Hemisphere distribution (Sanmartin & Ronquist, 2004) demonstrated area cladograms that do not fit well with the distribution pattern for grooved-elytra anillines under current consideration. In this biogeographical study Madagascan taxa typically branched either with African or with Indian/South East Asian taxa, in congruence with the geological scenario of the sequential breakup and rift of Africa, Madagascar/India, etc. from the Gondwana landmass, which happened more than 130 million years (MY) ago (Eagles & König 2008). Since that time Madagascar has not been connected to the landmasses (Antarctica and Australia), from which New Zealand split ~ 82–65MY ago (Laird & Bradshaw 2004; Wallis & Trewick 2009). For the complex of Anillina with grooved elytra, as for taxa of Gondwanan origin, it is unusual that none of the genera have been recorded from Africa, India, or South America. In general features, the modern distribution of group resembles the classic cladogram of the southern Gondwanan distribution pattern: ((Africa) (Madagascar (New Zealand (South America, Australia)))), first discussed by Brundin for Chironomidae (1966) and later documented for many other groups of animals and plants (e.g., Hoare & Dugdale 2003; Leschen & Michaux 2005; Cranston *et al.* 2010; Krosch *et al.* 2011; Liebherr *et al.* 2011; Seago & Leschen 2011). At the same time, the absence this group of Anillina from Africa and South America is unexpected and could be explained either by subsequent extinction or, perhaps more likely, because of inadequate sampling. Searching for concordant taxon-area relationships among other coleopteran taxa reveals only one group, namely the family Chaetosomatidae (Coleoptera: Cleroidea), with similar distribution pattern. The representatives of the family are hitherto known from New Zealand (2 genera) and Madagascar (1 genus) only (Leschen 2010). Indeed, much more data is needed

to understand whether these Madagascar-Australia/New Zealand ranges of taxa represent a modification of the classic Gondwanan distribution pattern, or indicate the result of historical extinction, or reflect the species undersampling, or may be shaped by other factors. In any case, I hope this review may pay attention of researchers to such unusual for the Gondwanan taxa distributional pattern.

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